

CLAIMS

What is claimed is:

1. A process of producing a coke fuel, said method comprising the steps:
- (a) obtaining a coke precursor material derived from crude oil, and having a volatile organic component; and
 - (b) subjecting said coke precursor material to a thermal cracking process for sufficient time and at sufficient temperature and under sufficient pressure so as to promote the production of sponge coke and to produce a coke product having volatile combustible material (VCM) present in an amount in the range of from about 13% to about 50% by weight;
- wherein said coke product is comprised of sponge coke in an amount in the range of about 40% to 100% by weight.
2. A process according to claim 1 wherein said coke precursor material is subjected to an efficient desalting process prior to step (b) and sodium levels are reduced to <15 ppm by weight.
5. A process according to claim 1 wherein said volatile combustible material in said coke product is in the range of from about 15% to about 30% by weight.
6. A coke product made in accordance with a process according to claim 1.

7. A coke product made in accordance with a process according to claim 2.
10. ^{a) 1/2 w w} A method for producing energy, said method comprising combusting a fuel, said fuel comprising coke, said coke comprising sponge coke in an amount in the range of about 40% to 100% by weight and having volatile combustible materials in an amount in the range from about 13% to about 50% by weight.
11. A method for producing energy according to claim 10 wherein said volatile combustible materials in said coke is in the range of from about 15% to about 30% by weight.
12. A method for producing energy according to claim 10 wherein said fuel comprises a mixture of said coke and coal, wherein the heat release rate ratio of said coke to said coal in said mixture is greater than about 1:4.
13. A method for producing energy according to claim 10 wherein said fuel consists essentially of coke comprising volatile combustible materials in amount in the range from about 13% to about 50% by weight.
14. A method for producing energy according to claim 10 wherein said fuel consists essentially of coke comprising volatile combustible materials in amount in the range from about 15% to about 30% by weight.
15. A method for removing undesirable flue gas components, said method comprising

(a) injection of conversion reagents with sufficient mixing and sufficient residence time at sufficient temperature to convert undesirable flue gas components to collectible particulates upstream of a particulate control device (PCD) and

(b) collecting said particulates in particulate control device, said particulate control device includes, but is not limited to, a PCD process selected from the group consisting of electrostatic precipitators (dry or wet), filtration, cyclones, and conventional wet scrubbers.

19. 16. A method for removing undesirable flue gas components according to claim 15, wherein unreacted flue gas conversion reagents are recycled to increase reagent utilization, wherein said recycle rate exceeds 5% by weight of the collected flyash.

19. 17. A method for removing undesirable flue gas components according to claim 15, wherein spent flue gas conversion reagents are regenerated and reused, wherein said regeneration rate exceeds 70% by weight of the collected flyash, and less than 30% of the collected flyash is disposed as a purge (or blowdown) stream, containing high concentration of impurities. Said regeneration method includes, but is not limited to, a process from the group of hydration, precipitation, and other unit operations.

19. 18. A method for removing undesirable flue gas components according to claim 15, wherein purge stream from the regeneration process is used as a resource for valuable metals, wherein said valuable metals are extracted and purified.

19. A process of producing coke, said process comprising the steps:
- (a) Providing a coke precursor material derived from fossil carbonaceous origin; and
 - (b) Subjecting said coke precursor material to a thermal cracking process for sufficient time and at sufficient temperature and under sufficient pressure so as to produce a coke product having volatile combustible materials (VCMs) present in an amount in the range from about 13% to about 50% by weight.
20. A process according to claim 19 wherein said coke precursor material is derived from crude oil, coal, or tar sands.
21. A process according to claim 19 wherein said VCMs are present in an amount in the range of from about 15% to about 30% by weight.
22. A process according to claim 19 further comprising altering the crystalline structure of said coke product to promote production of essentially sponge coke with sufficient porosity and sufficient physical & chemical properties to provide low to medium grades of adsorption quality carbon.
23. A process according to claim 22 further comprising introducing at least one chemical compound into said thermal cracking process to improve the adsorption characteristics of said coke product.
24. A process according to claim 23 wherein said at least one chemical compound is selected from the group consisting of hydrogen, plastics, wood wastes, coals, and non-volatile hydrocarbons with appropriate cracking/coking characteristics.

25. A process according to claim 22 wherein coke adsorption characteristics are used for further coke treatment, said coke treatment including the removal of at least one undesirable chemical compound, said coke treatment comprising the steps:
- (a) Selective addition of at least one chemical reactant in a fluid that passes through said coke; and
 - (b) Maintaining sufficient temperature, sufficient pressure, and sufficient residence time to cause a reaction of desired degree.
26. A process according to claim 25 wherein said at least one undesirable chemical compound is sulfur, nitrogen, or a metal.
27. A process according to claim 25 wherein said fluid is a coke quench medium.
28. A process according to claim 25 further comprising calcining said coke to remove excessive VCMs and alter crystalline structure to low porosity coke with sufficient density such that said coke is adapted to be used for steel or aluminum manufacture.
29. A process according to claim 22 wherein coke adsorption characteristics are used for further coke treatment, said coke treatment including the addition of at least one desirable chemical compound in a fluid that passes through said coke, said at least one desirable chemical compound selected from the group consisting of VCMs, chemical adsorbents, and oxygen-containing compounds.
30. A process according to claim 29 wherein said fluid is a coke quench medium.
31. A process according to claim 29 wherein said chemical adsorbents are SO_x

sorbents.

32. A process according to claim 19 further comprising using an excess capacity of said thermal cracking process to recycle at least one plastic, wherein the recycling process comprises the steps:
- (a) Providing said at least one plastic;
 - (b) Pulverizing said at least one plastic to less than about 100 mesh; and
 - (c) Adding said at least one plastic to said thermal cracking process at a point with sufficient temperature to fluidize said at least one plastic and sufficient residence time to mix with other feed and achieve desired cracking temperature prior to a thermal cracking/coking reaction chamber.
33. A process according to claim 32 wherein said at least one plastic is added to said thermal cracking process in a feed recycle stream downstream of a fractionator.
34. A coke product made in accordance with a process according to claim 19.
35. A coke product according to claim 34 wherein said coke product is adapted for use as an adsorption media.
36. A coke product according to claim 35 wherein said coke product is adapted to be used for fuel after serving as said adsorption media.
37. A coke product according to claim 34 wherein said coke product is adapted for use as an adsorption media for adsorption and removal of at least one undesirable flue gas component from a combustion process.

38. A coke product according to claim 37 wherein said at least one undesirable flue gas component is selected from the group consisting of sulfur oxides, nitrogen oxides, carbon dioxide, dioxins, furans, mercury compounds, and other air toxics comprised of hydrocarbon or a metal compound.
39. A coke product according to claim 34 wherein the sulfur content of said coke product is adapted to enhance the adsorption of mercury and other metal compounds.
40. A coke product made in accordance with a process according to claim 22.
41. A coke product according to claim 40 wherein said coke product is adapted for use as an adsorption media.
42. A coke product according to claim 41 wherein said coke product is adapted to be used for fuel after serving as said adsorption media.
43. A coke product according to claim 40 wherein said coke product is adapted for use as an adsorption media for adsorption and removal of at least one undesirable flue gas component from a combustion process.
44. A coke product according to claim 43 wherein said at least one undesirable flue gas component is selected from the group consisting of sulfur oxides, nitrogen oxides, carbon dioxide, dioxins, furans, mercury compounds, and other air toxics comprised of hydrocarbon or a metal compound.
45. A coke product according to claim 40 wherein the sulfur content of said coke product is adapted to enhance the adsorption of mercury and other metal compounds.

46. A coke product made in accordance with a process according to claim 23.
47. A coke product according to claim 46 wherein said coke product is adapted for use as an adsorption media.
48. A coke product according to claim 47 wherein said coke product is adapted to be used for fuel after serving as said adsorption media.
49. A coke product according to claim 46 wherein said coke product is adapted for use as an adsorption media for adsorption and removal of at least one undesirable flue gas component from a combustion process.
50. A coke product according to claim 49 wherein said at least one undesirable flue gas component is selected from the group consisting of sulfur oxides, nitrogen oxides, carbon dioxide, dioxins, furans, mercury compounds, and other air toxics comprised of hydrocarbon or a metal compound.
51. A coke product according to claim 46 wherein the sulfur content of said coke product is adapted to enhance the adsorption of mercury and other metal compounds.
52. A coke product made in accordance with a process according to claim 25.
53. A coke product according to claim 52 wherein said coke product is adapted for use as an adsorption media.
54. A coke product according to claim 53 wherein said coke product is adapted to be used for fuel after serving as said adsorption media.

55. A coke product according to claim 52 wherein said coke product is adapted for use as an adsorption media for adsorption and removal of at least one undesirable flue gas component from a combustion process.
56. A coke product according to claim 55 wherein said at least one undesirable flue gas component is selected from the group consisting of sulfur oxides, nitrogen oxides, carbon dioxide, dioxins, furans, mercury compounds, and other air toxics comprised of hydrocarbon or a metal compound.
57. A coke product according to claim 52 wherein the sulfur content of said coke product is adapted to enhance the adsorption of mercury and other metal compounds.
58. A coke product according to claim 52 wherein the sulfur content of said coke product is sufficiently reduced to enable said coke product to be used for steel or aluminum manufacture.
59. A coke product made in accordance with a process according to claim 29.
60. A coke product according to claim 59 wherein said coke product is adapted for use as an adsorption media.
61. A coke product according to claim 60 wherein said coke product is adapted to be used for fuel after serving as said adsorption media.
62. A coke product according to claim 59 wherein said coke product is adapted for use as an adsorption media for adsorption and removal of at least one undesirable flue gas component from a combustion process.

63. A coke product according to claim 62 wherein said at least one undesirable flue gas component is selected from the group consisting of sulfur oxides, nitrogen oxides, carbon dioxide, dioxins, furans, mercury compounds, and other air toxics comprised of hydrocarbon or a metal compound.
64. A coke product according to claim 59 wherein the sulfur content of said coke product is adapted to enhance the adsorption of mercury and other metal compounds.
65. A coke product according to claim 59 wherein the sulfur content of said coke product is sufficiently reduced to enable said coke product to be used for steel or aluminum manufacture.
66. A coke product made in accordance with a process according to claim 32.
67. A coke product according to claim 66 wherein said coke product is adapted for use as an adsorption media.
68. A coke product according to claim 67 wherein said coke product is adapted to be used for fuel after serving as said adsorption media.
69. A coke product according to claim 66 wherein said coke product is adapted for use as an adsorption media for adsorption and removal of at least one undesirable flue gas component from a combustion process.
70. A coke product according to claim 69 wherein said at least one undesirable flue gas component is selected from the group consisting of sulfur oxides, nitrogen oxides, carbon dioxide, dioxins, furans, mercury compounds, and

other air toxics comprised of hydrocarbon or a metal compound.

71. A coke product according to claim 66 wherein the sulfur content of said coke product is adapted to enhance the adsorption of mercury and other metal compounds.
72. A coke product according to claim 66 wherein the sulfur content of said coke product is sufficiently reduced to enable said coke product to be used for steel or aluminum manufacture.
73. A method for producing energy, said method comprising combusting a fuel, said fuel comprising coke, said coke comprising essentially high porosity sponge coke and volatile combustible materials (VCMs) in amount in the range from about 13% to about 50% by weight.
74. A method according to claim 73 wherein said VCMs are present in an amount in the range of from about 15% to about 30% by weight.
75. A method for producing energy according to claim 73 wherein said fuel comprises a mixture of said coke and at least one other fuel, and wherein the heat release ratio of said coke to said at least one other fuel in said mixture is greater than about 1:4.
76. A method according to claim 75 wherein said at least one other fuel is coal, fuel oil, natural gas, by-products, or wastes.
- ~~77.~~ A process according to claim 2 wherein said sodium levels are reduced to less than about 5 ppm by weight.

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78. A process according to claim 1 wherein said coke product is comprised of sponge coke in an amount in the range of about 60% to 100% by weight.
79. A method according to claim 10 wherein said coke has sodium present in an amount less than about 25 ppm by weight.
80. A method according to claim 10 wherein said coke comprises sponge coke in an amount in the range of about 60% to 100% by weight.
81. A coke comprising sponge coke in an amount in the range of about 40% to 100% by weight, said coke having volatile combustible material (VCM) present in an amount in the range of from about 13% to about 50% by weight.
82. A coke according to claim 81 wherein said sponge coke is in an amount of about 60% to 100% by weight.
83. A coke according to claim 81 wherein said volatile combustible material (VCM) is present in an amount in the range of from about 15% to about 30% by weight.
84. A coke according to claim 81 wherein said coke has sodium present in an amount less than about 25 ppm by weight.
85. A process according to claim 1 wherein said thermal cracking process includes adding predetermined hydrocarbon compounds to promote an increase of the VCM content of said coke product to within the range of from about 13% to about 50% by weight.
86. A process according to claim 1 further comprising adding predetermined

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hydrocarbon compounds to said coke precursor material to promote an increase of the VCM content of said coke product to within the range of from about 13% to about 50% by weight.

87. A process according to claim 1 further comprising adding predetermined hydrocarbon compounds to said coke precursor material which are adapted to decompose at predetermined temperatures to promote the production of sponge coke during said thermal cracking process to within the range of about 40% to 100% by weight of said coke product.